OIPE JC42
JUN 13 2001
PATENT & TRADEMARK OFFICE

~~06-14-01~~ 0320 ~~0450~~

T

Attorney Docket No.: 013777.002

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: William George Krieski, et al.

Serial No.: 09/840542

Filed: April 23, 2001

Title: Protocol Monitor
Commissioner for Patents
U.S. Patent & Trademark Office
Washington, D.C. 20231

TRANSMITTAL OF FORMAL DRAWINGS

Please find attached:

(a) the formal drawings for this application
Number of Sheets 43

Bentley J. Olive
SIGNATURE OF ATTORNEY

Reg. No.: 44,985

Bentley J. Olive
Type or print name of attorney

Tel. No.: (919) 286-8000

2200 W. Main Street, Suite 800
Address

Durham, North Carolina 27705

Docket No. 013777.002

CERTIFICATE OF MAILING (37 C.F.R. § 1.8(a))

Date of Deposit: June 13, 2001

Inventor: William George Krieski, et al.

Application No.: 09/840542

Filed: April 23, 2001

For: Protocol Monitor

I hereby certify that the following documents:

Certificate Of Mailing (37 C.F.R. § 1.8(a)), and

1. Transmittal of Formal Drawings;
2. Formal Drawings (43 pages); and
3. Receipt acknowledgment postcard

are being deposited with the United States Postal on the date indicated above with sufficient postage as express mail addressed to: Commissioner for Patents, U.S. Patent and Trademark Office, Washington, D.C. 20231.

Ben Bruner
(Name of Person Mailing Documents)

Ben Br
(Signature of Person Mailing Documents)

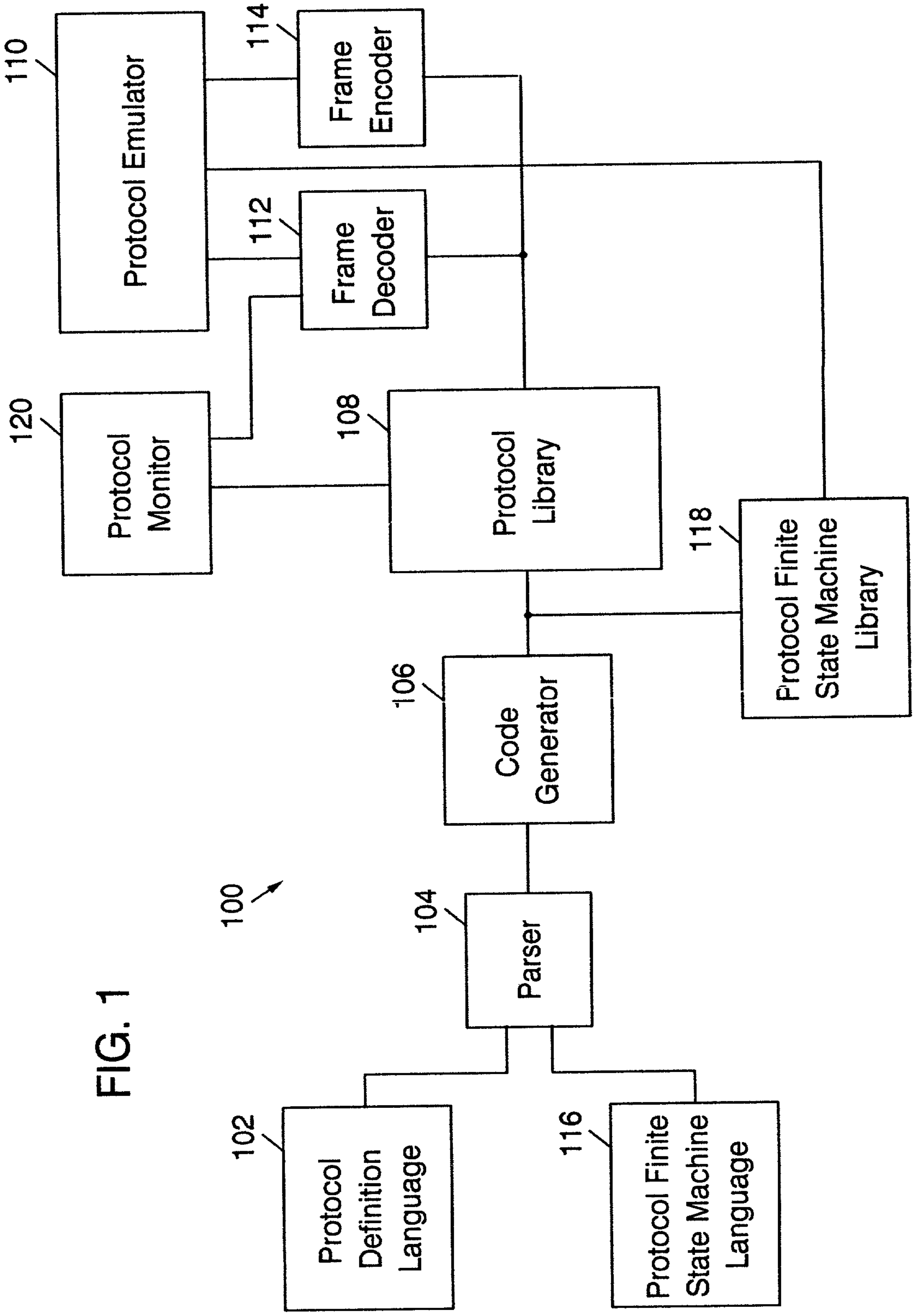

110
Protocol Emulator
114
Frame Encoder
112
Frame Decoder
120
Protocol Monitor
108
Protocol Library
118
Protocol Finite State Machine Library
106
Code Generator
100
104
Parser
102
Protocol Definition Language
116
Protocol Finite State Machine Language

FIG. 1

FIG. 2
(PRIOR ART)

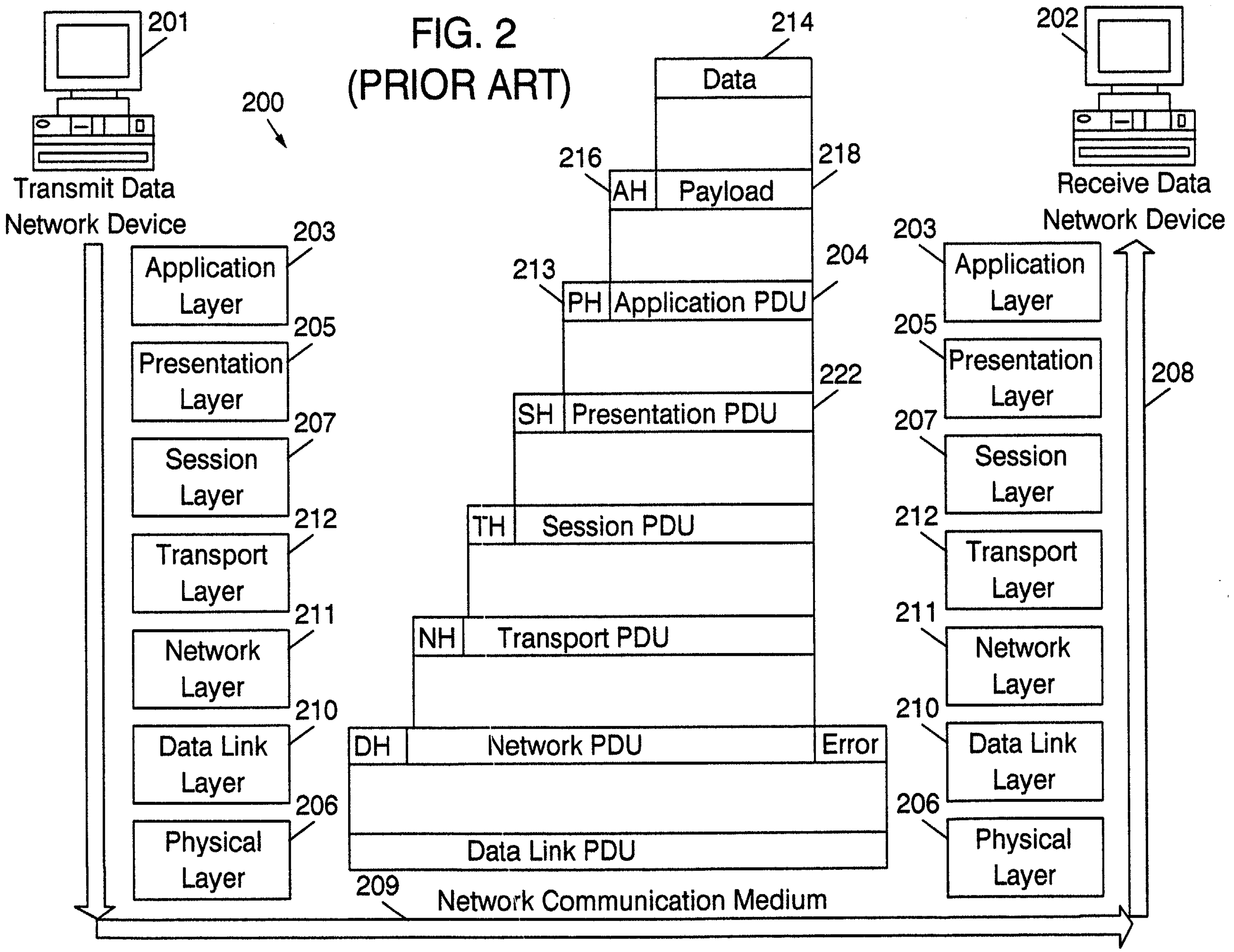


FIG. 3
(PRIOR ART)

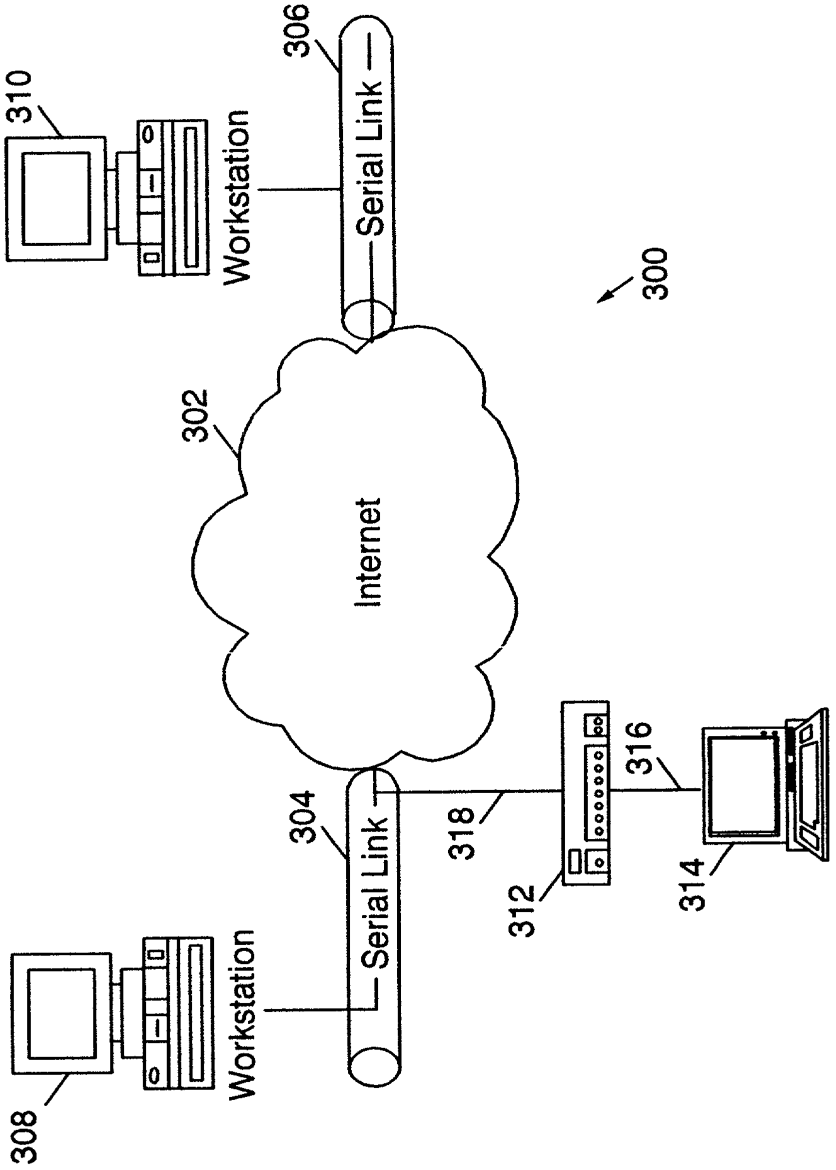
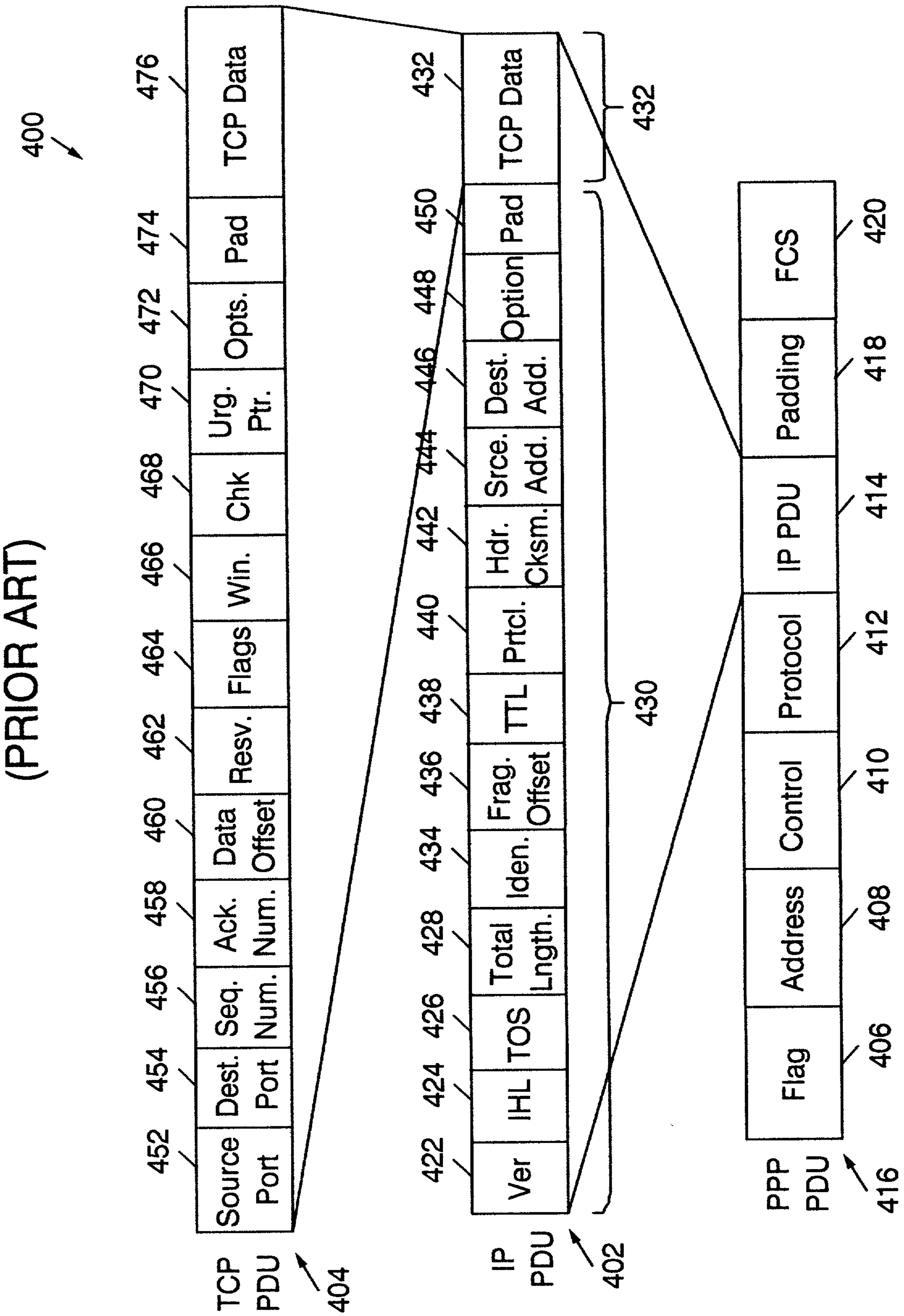


FIG. 4
(PRIOR ART)



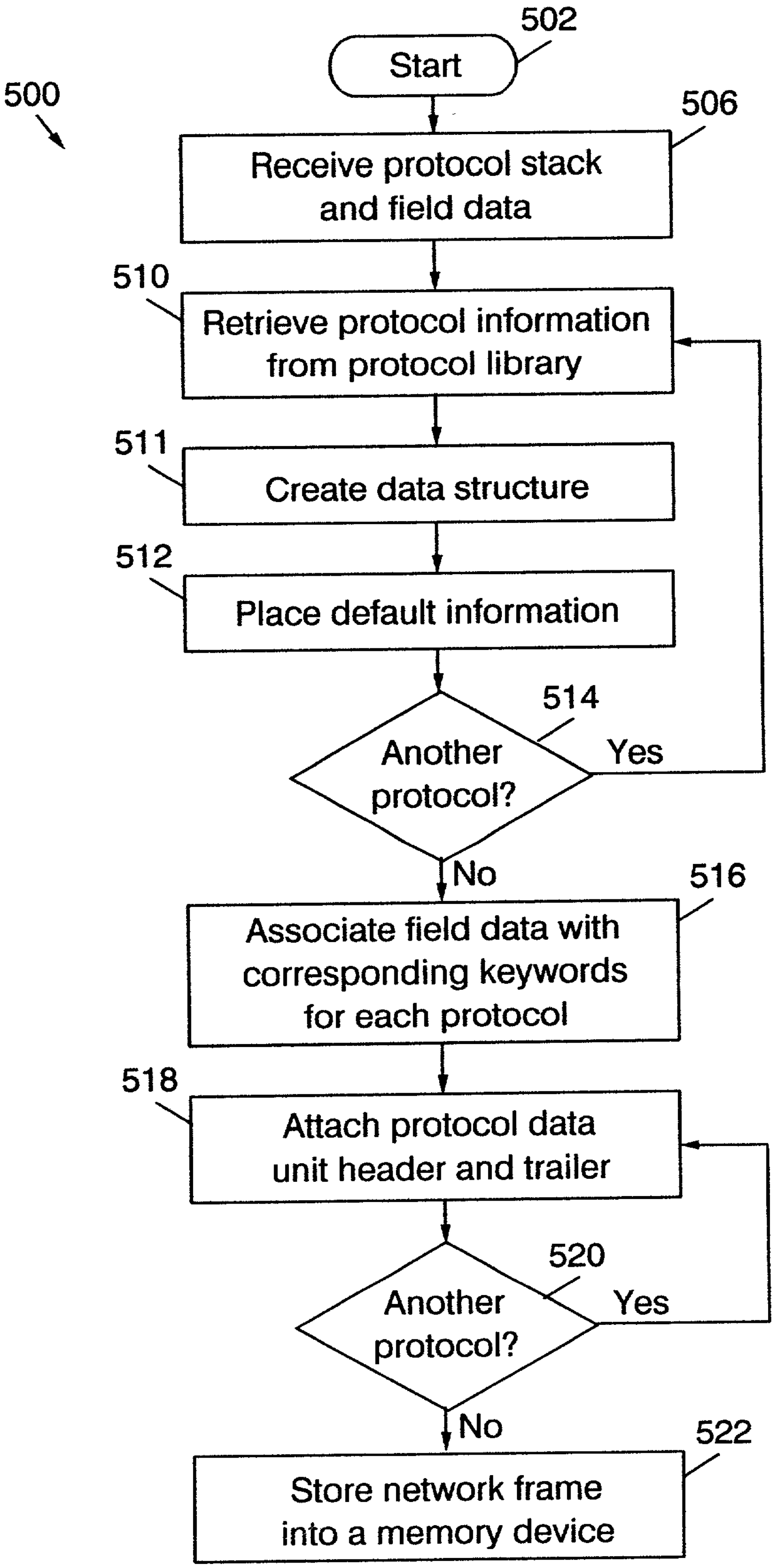
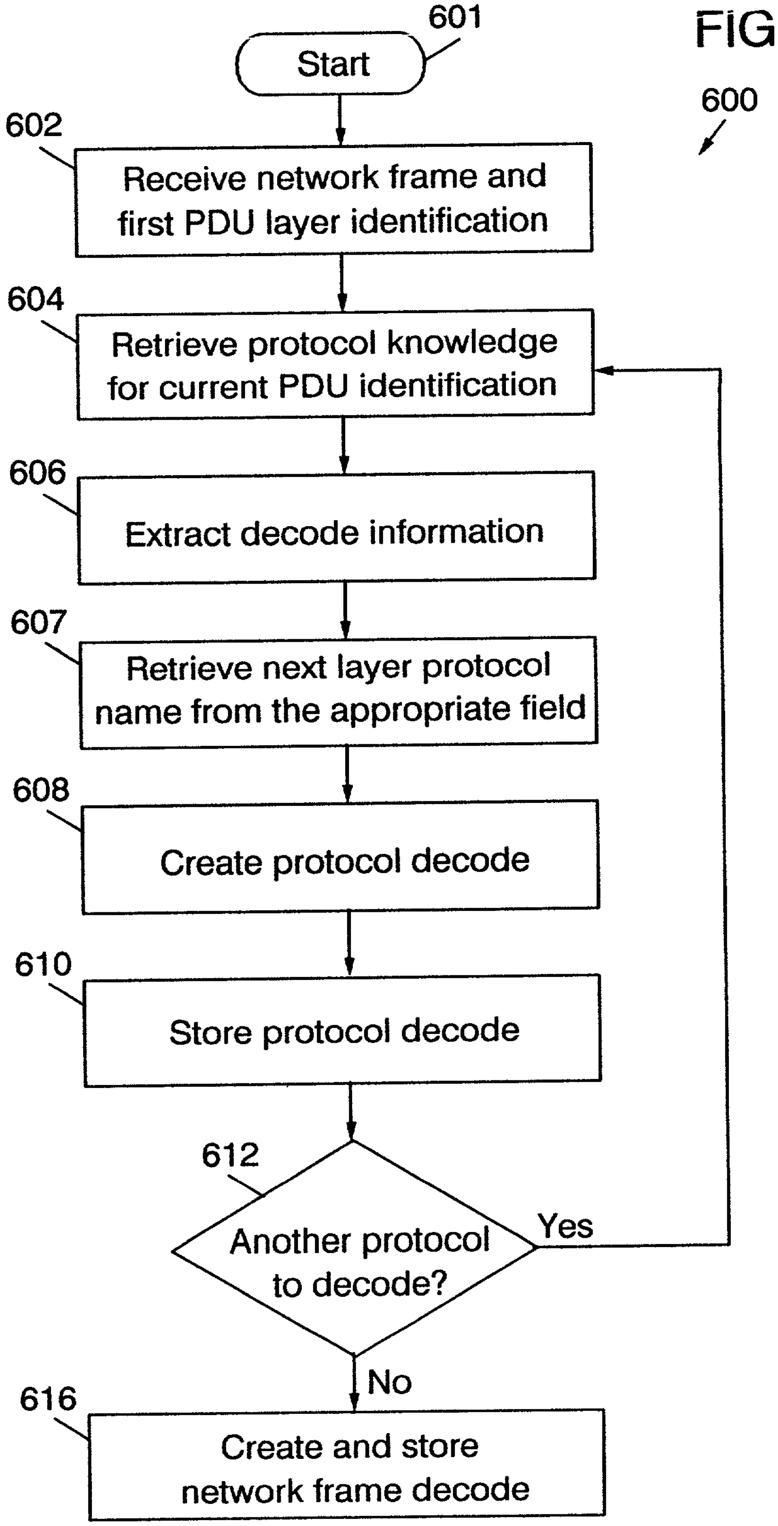

500
502
Start
506
Receive protocol stack and field data
510
Retrieve protocol information from protocol library
511
Create data structure
512
Place default information
514
Another protocol?
Yes
No
516
Associate field data with corresponding keywords for each protocol
518
Attach protocol data unit header and trailer
520
Another protocol?
Yes
No
522
Store network frame into a memory device

FIG. 5

FIG. 6


601
Start
600
602
Receive network frame and first PDU layer identification
604
Retrieve protocol knowledge for current PDU identification
606
Extract decode information
607
Retrieve next layer protocol name from the appropriate field
608
Create protocol decode
610
Store protocol decode
612
Another protocol to decode?
Yes
No
616
Create and store network frame decode

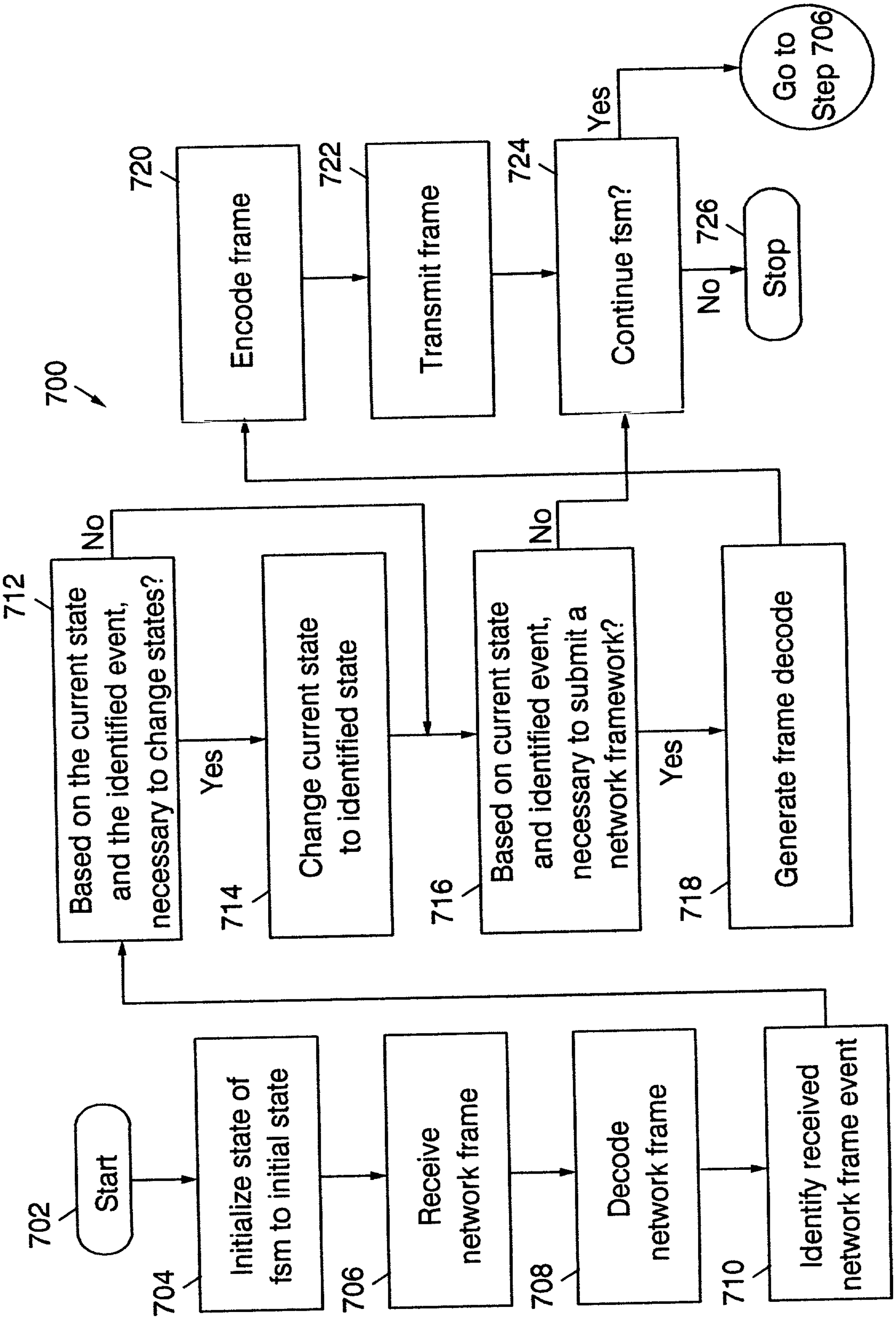

700
702
Start
704
Initialize state of fsm to initial state
706
Receive network frame
708
Decode network frame
710
Identify received network frame event
712
Based on the current state and the identified event, necessary to change states?
Yes
No
714
Change current state to identified state
716
Based on current state and identified event, necessary to submit a network framework?
Yes
No
718
Generate frame decode
720
Encode frame
722
Transmit frame
724
Continue fsm?
Yes
No
726
Stop
Go to Step 706

FIG. 7

FIG. 8A

```
802
 protocol "IP" {// ----------------------
         len=valueof(field "Total Length")*8
         minLen=20*8 //just header
   804   maxLen=65535*8
    header "IP Header"
806      payload "IP Payload"
   808
    header "IP Header" {// ----------------
810
         len=valueof(field "Header Length")*32
   812   field "Version"          818
   816   field "Header Length"
         compound_field "Type Of Service"
   814   field "Total Length"
   824                                        820
     field "Identification" {len=16 default=291}
     compound_field "Flags"                              822
815  field "Fragment Offset" {len=13 desc="in 64 bits units"}  826
     field "Time To Live" {len=8 default=30 desc="seconds"}
     field "Protocol"              830
828  field "Header Checksum"
     field "Source IP Address" {len=32 display=ipv4 field_type=
832          must_encode}
     field "Destination IP Address" {
834                len=32
                   display=ipv4
                   field_type = must_encode
         }
```

FIG. 8B

816

```
repeat {
    len=valueof(field "Header Length") - 5 )*32//includes padding
  compound_field "Options"
}

field "Version" {
            len=4
            default=4
            possible_values={
    0,15:"Reserved"
    1-3:"Unassigned"
            6-14:"Unassigned"
4:"IP Internet Protocol"
5:"ST ST Datagram Mode"
}}

field "Header Length" {
            len=4
            minValue=5
            desc="in 32 bit units"
            default=eval_fn(len, "IP", "IP Header", "/32")
}

field "Total Length" {
            minValue=20
            len=16
            desc="in octets include header length"
            default=eval_fn(len, "IP", "IP", "/8")
}
field "Header Checksum" {
            len=16
            default=eval_fn(checksum, "IP", "IP Header")
            display=hex
}
```

FIG. 8C

```
compound_field "Type Of Service" { // ---------
            display=hex
            field "precedence" {
            len=3
            possible_values= {
0:"Routine"
1:"Priority"
2:"Immediate"
3:"Flash"
4:"Flash override"
5:"CRITIC/ECP"
6:"Internetwork Control"
7:"Network Control"
}}
field "Delay" {
len=1
            possible_values={0:"normal" 1:"low"}}
field "Throughput" {
            len=1
possible_values={0:"normal" 1:"high"}}
field "Reliability" {
            len=1
possible_values={0:"normal" 1:"high"}}
field "Monetary Cost" {
            len=1
possible_values={0:"normal" 1:"low"}}
field "Unused" {
            len=1
            possible_values={0:"valid"}}
}// end of field "Type of Service" -----------
```

FIG. 8D

```
compound_field "Flags" {
                len=3
                display=hex
field "Reserved" {
                len=1
                possible_values={0:"valid"}}
field "Fragment" {
                len=1
                possible_values={0:"May Fragment" 1:"Don't Fragment"}}
field "Fragments" {
                len=1
                possible_values={0:"last" 1:"more"}}
}
compound_field "Options" {//------------
     optional = (valueof(field "Header Length") > 5)
     compound_field "Option Tuple"
{
len=8;
display=hex
field "Copied Flag" {
                len=1
                possible_values={0:"not copied into all fragments
             0:"not copied into all fragments on fragmentation"
     1:"copied into all fragments on fragmentation"
}}
field "Option Class" {
                len=2
                possible_values={
                0:"control"
      1:"reserved for future use"
                2."debugging and measurement"
                3:"reserved for future use"
}}
```

FIG. 8E

```
field "Option Number" {
                len=5
                field_type=mulopt_other_fld
                possible_values={
                0:"end of option list"
          1:"no operation"
                2:"security"
                3:"loose source routing"
          4:"internet timestamp"
                7:"record route"
          8:"stream ID"
                9:"strict source routing"
}}
}

switch(valueof(field "Option Number")){
 0:null
 1:null
 2:compound_field "Security"
 3:compound_field "Loose Source Routing"
 9:compound_field "Strict Source Routing"
 7:compound_field "Record Route"
 8:compound_field "Stream ID"
 4:compound_field "Internet Timestamp"
}

compound_field "Security"{
                len=80
                field "Security Length" {
                        len=8
                        possible_values={0x0b:"valid"}}
```

FIG. 8F

```
                field "Security: Security"
                field "Compartments" {len=16}
                field "Handling Restrictions" {len=16}
                field "Transmission Control Code" {len=24}

                field "Security Security" {
                len=16
                possible_values={
                0:"unclassified"
                0xf135:"confidential"
                0x0789a:"EFTO"
                0xbc4d:"MMMM"
                0x5e26:"PROG"
                0xaf13:"Restricted"
                0xd788:"Secret"
                0x6bc5:"Top Secret"
             0x35e2,0x9af1,0x4d78,0x24bd,0x135e,0x89af,0xc4d6,0xe26b:
                "Reserved for future use"
  }}
 }

  compound_field "Strict Source Routing" {
   len=(valueof(field "Strict Source Routing Length")-1*8
   field "Strict Source Routing Length" {len=8 }
   field "Strict Source Routing Pointer" {len=8 minValue=4}

  repeat {
   len=(valueof(field "Strict Source Routing Length")-3)*8
   field "source address" {len=32 display=ipv4}
   }
 }
```

FIG. 8G

```
 compound_field "Loose Source Routing" {
   len=(valueof(field "Loose Source Routing Length")-1*8
   field "Loose Source Routing Length" {len=8 }
   field "Loose Source Routing Pointer" {len=8 minValue=4}
 repeat {
   len=(valueof(field "Loose Source Routing Length")-3)*8
   field "source address" {len=32 display=ipv4}
   }
}
 compound_field "Record Routing" {
   len=(valueof(field "Record Routing Length")-1)*8
   field "Record Routing Length" {len=8 }
   field "Record Routing Pointer" {len=8 minValue=4}
 repeat {
   len=(valueof(field "Record Routing Length")-3)*8
   field "source address" {len=32 display=ipv4}
   }
}
 compound_field "Stream ID" {
   len=24
   field "Stream ID Length" {
       len=8
                default=4
                possible_values=
                        0x04:"valid"
           }}
   field "ID" {len=16 default=4}
}
```

FIG. 8H

```
      compound_field "Internet Timestamp" {
        field "Internet Timestamp Length" {len=8 }
        field "Internet Timestamp Pointer" {len=8 }
        field "Overflow" {
                len=4
          desc="number of IP modules that cannot register timestamps"
                }
        field "Flag" {
                len=4
                possible_values=1
          0:"time stamps only, stored in consecutive 32-bit words"
          1:"each timestamp is preceded with internet address"
          3:"the internet address fields are prespecified"
        }}

    } // end of Internet Timestamp
} // end of field "option" ------------------

} // end of field "IP" ---------------------

field "Protocol" {

len=8
default=255
field_type = mulopt_prtcl_fld
display=hex
possible_values={ // -------------------
    0:"HOPOPT (IPv6 Hop-by-Hop Option)"
    1:"ICMP (Internet Control Message)"
    2:"IGMP (Internet Group Management)"
    3:"GGP (Gateway-to-Gateway)"
```

FIG. 8I

4:"IP (IP in IP encapsulation)"
5:"ST (Stream)"
6:"TCP"
7:"CBT"
8:"EGP (Exterior Gateway Protocol)"
9:"IGP (any private interior gateway)"
10:"BBN-RCC-MON (BBN RCC Monitoring)"
11:"NVP-II (Network Voice Protocol)"
12:"PUP"
13:"ARGUS"
14:"EMCON"
15:"XNET (Cross Net Debugger)"
16:"CHAOS"
17:"UDP"
18:"MUX (Multiplexing)"
19:"DCN-MEAS (DCN Measurement Subsystems)"
20:"HMP (Host Monitoring)"
21:"PRM (Field Radio Measurement)"
22:"XNS-IDP (XEROX NS IDP)"
23:"TRUNK-1 (Trunk-1)"
24:"TRUNK-2 (Trunk-2)"
25:"LEAF-1 (Leaf-1)"
26:"LEAF-2 (Leaf-2)"
27:"RDP (Reliable Data Protocol)"
28:"IRTP (Internet Reliable Transaction)"
29:"ISO-TP4 (ISO Transport Protocol Class 4)"
30:"NETBLT (Bulk Data Transfer Protocol)"
31:"MFE-NSP (MFE Network Services Protocol)"
32:"MERIT-INP (MERIT Internodal Protocol)"
33:"SEP (Sequential Exchange Protocol)"
34:"3PC (Third Party Connect Protocol)"
35:"IDPR (Inter-Domain Policy Routing Protocol)"
36:"XTP (XTP)"

FIG. 8J

37:"DDP (Datagram Delivery Protocol)"
38:"IDPR-CMTP (IDPR Control Message Transport Protocol)"
39:"TP++ (TP++ Transport Protocol)"
40:"IL (IL Transport Protocol)"
41:"IPv6 (IPv6)"
42:"SDRP (Source Demand Routing Protocol)"
43:"IPv6-Route (Routing Header for IPv6)"
44:"IPv6-Frag (Fragment Header for IPv6)"
45:"IDRP (Inter-Domain Routing Protocol)"
46:"RSVP (Reservation Protocol)"
47:"GRE (General Routing Encapsulation)"
48:"MHRP (Mobile Host Routing Protocol)"
49:"BNA"
50:"ESP (Encap Security Payload for IPv6)"
51:"AH (Authentication Header for IPv6)"
52:"I-NLSP (Integrated Net Layer Security TUBA)"
53:"SWIPE (IP with Encryption)"
54:"NARP (NBMA Address Resolution Protocol)"
55:"MOBILE (IP Mobility)"
56:"TLSP (Transport Layer Security Protocol)"
57:"SKIP"
58:"IPv6-ICMP (ICMP for IPv6)"
59:"IPv6-NoNxt (No Next Header for IPv6)"
60:"IPv6-Opts (Destination Options for IPv6)"
61:"AHP (Any Host Internal Protocol)"
62:"CFTP (CFTP)"
63:"ALN (Any Local Network)"
64:"SAT-EXPAK (SATNET and Backroom EXPAK)"
65:"KRYPTOLAN (Kryptolan)"
66:"RVD (MIT Remote Virtual Disk Protocol)"
67:"IPPC (Internet Pluribus Field Core)"
68:"ADFS (Any Distributed File System)"
69:"SAT-MON (SATNET Monitoring)"
70:"VISA (VISA Protocol)"

FIG. 8K

71:"IPCV (Internet Field Core Utility)"
72:"CPNX (Computer Protocol Network Executive)"
73:"CPHB (Computer Protocol Heart Beat)"
74:"WSN (Wang Span Network)"
75:"PVP (Field Video Protocol)"
76:"BR-SAT-MON (Backroom SATNET Monitoring)"
77:"SUN-ND (SUN ND PROTOCOL-Temporary)"
78:"WB-MON (WIDEBAND Monitoring)"
79:"WB-EXPAK (WIDEBAND EXPAK)"
80:"ISO-IP (ISO Internet Protocol)"
81:"VMTP"
82:"SECURE-VMTP"
83:"VINES"
84:"TTP"
85:"NSFNET-IGP"
86:"DGP (Dissimilar Gateway Protocol)"
87:"TCF"
88:"EIGRP"
89:"OSPF"
90:"Sprite-RPC (Sprite RPC Protocol)"
91:"LARP (Locus Address Resolution Protocol)"
92:"MTP (Multicast Transport Protocol)"
93:"AX.25 (AX.25 Frames)"
94:"IPIP (IP-within-IP Encapsulation Protocol)"
95:"MICP (Mobile Internetworking Control Pro)"
96:"SCC-SP (Semaphore Communications Sec. Pro)"
97:"ETHERIP (Ethernet-within-IP Encapsulation)"
98:"ENCAP (Encapsulation Header)"
99:"APES (Any Private Encryption Scheme)"
100:"GMTP"
101:"IFMP (Ipsilon Flow Management Protocol)"
102:"PNNI (PNNI over IP)"
103:"PIM (Protocol Independent Multicast)"
104:"ARIS"

FIG. 8L

```
        105:"SCPS"
        106:"QNX"
        107:"A/N (Active Networks)"
        108:"IPPCP (IP Payload Compression Protocol)"
        109:"SNP (Sitara Networks Protocol)"
        110:"Compaq-Peer (Compaq Peer Protocol)"
        111:"IPX-in-IP"
        112:"VRRP (Virtual Router Redundancy Protocol)"
        113:"PGM (PGM Reliable Transport Protocol)"
        114:"AHOP (Any 0-hop protocol)"
        115-254:"Unassigned"
        255:"Reserved"
  }} // end of field "protocol" · - - - - - - - - - - - - - - - - -

        } // end of field "IP header"  - - - - - - - - - - - - - - -

836
  \ payload "IP Payload" {// - - - - - - - - - - - - - - - - - -
         / switch(valueof(field "Protocol")) {
   838         1:protocol "ICMP"
        2:protocol "IGMP"
        6:protocol "TCP"
        17:protocol "UDP"
        46:protocol "RSVP"
        47:protocol "GRE"
        89.protocol "OSPF"
        }
  } // end of packet "IP payload"  - - - - - - - - - - - - - - -
}
```

FIG. 9A

```
*/
/*****************************************************************************
Constants
****************************************************************** ************** /
//========= LCP Options  =================================
int  OPT_PASSIVE  = 1;    // Don't die if we don't get a response
int  OPT_RESTART = 2;    // Treat 2nd OPEN as DOWN, UP
int  OPT_SILENT = 4;       // Wait for peer to speak first

//========= LCP States    =================================
int  INITIAL_STATE = 0;
int  STARTING_STATE = 1;
int  CLOSED_STATE = 2;
int  STOPPED_STATE = 3;
int  CLOSING_STATE = 4;
int  STOPPING_STATE = 5;
int  REQ_SENT_STATE = 6;
int  ACK_RCVD_STATE = 7;
int  ACK_SENT_STATE = 8;
int  OPENED_STATE = 9;

//========= LCP Events    =================================
int  UP_EVENT = 0;
int  DOWN_EVENT = 1;
int  OPEN_EVENT = 2;
int  CLOSE_EVENT = 3;
int  TIMEOUT_POS_EVENT = 4;
```

FIG. 9B

```
int  TIMEOUT_NEG_EVENT = 5;
int  RCV_CFG_REQ_POS_EVENT = 6;
int  RCV_CFG_REQ_NEG_EVENT = 7;
int  RCV_CFG_ACK_EVENT = 8;
int  RCV_CFG_NACK_EVENT = 9;
int  RCV_TERM_REQ_EVENT = 10;
int  RCV_TERM_ACK_EVENT = 11;
int  RCV_UNKN_CODE_EVENT = 12;
int  RCV_CODE_REJECT_POS_EVENT = 13;
int  RCV_CODE_REJECT_NEG_EVENT = 14;
int  RCV_ECHO_REQ_REPLY_EVENT = 15;

//========= Transition Constants ============================
int  TRANSITION_CNST_FALSE = 0:
int  TRANSITION_CNST_TRUE = 1:

902~fsm    "LCP"
    {
904~state  INITIAL_STATE                          924
926 {                                            ↙
   ~UP_EVENT   -                          CLOSED_STATE
928~OPEN_EVENT InitialStOpenEvent         STARTING_STATE

    } // INITIAL
```

FIG. 9C

```
906
   state STARTING_STATE
   {
   UP_EVENT
   \
             switch (enabledSilent())
   \
                  TRANSITION_CNST_TRUE:    StareingStUpEvEnabledSilentTrue
   STOPPED_STATE
                  TRANSITION_CNST_FALSE:   StareingStUpEvEnabledSilentFalse
   REQ_SENT_STATE
                }
   \
   CLOSE_EVENT      -
   } / / STARTING
908
   state CLOSED_STATE
   {
   DOWN_EVENT                                                  INITIAL_STATE
   \
             switch (enabledSilent())
   \
```

```
        {
    \
            TRANSITION_CNST_TRUE:       ClosedStOpenEvEnabledSilentTRUE
    STOPPED_STATE   \
            TRANSITION_CNST_FALSE:      ClosedStOpenEvEnabledSilentFALSE
    REQ_SENT_STATE  \
        }
    \
    RCV_CFG_REQ_POS_EVENT           ClosedStRcvCfgReqPosEv          CLOSED_STATE
    RCV_CFG_REQ_NEG_EVENT           ClosedStRcvCfgReqNegEv          CLOSED_STATE
    RCV_CFG_ACK_EVENT               ClosedStRcvCfgAckEv             CLOSED_STATE
    RCV_CFG_NACK_EVENT              ClosedStRcvCfgNackEv            CLOSED_STATE
    RCV_CODE_REJECT_POS_EVENT       RcvCodeRejectPosEv              CLOSED_STATE
    RCV_CODE_REJECT_NEG_EVENT       ClosedStRcvCodeRejectNegEv      CLOSED_STATE
    RCV_ECHO_REQ_REPLY_EVENT        RcvEchoReqReplyEv               CLOSED_STATE

    } // CLOSED
910
  ~ state STOPPED_STATE
    {
    DOWN_EVENT                      StoppedStDownEv                 STARTING_STATE
    OPEN_EVENT
    \
            switch(enabledRestart ())
    \
        {
    \
            TRANSITION_CNST_TRUE:   StoppedStOpenEvEnabledRestartTRUE   STOPPED_STATE
    \
```

FIG. 9D

FIG. 9E

```
    }

\
CLOSE_EVENT                    -                              CLOSED_STATE
RCV_CFG_REQ_POS_EVENT          StoppedStRcvCfgReqPosEv        ACK_SENT_STATE
RCV_CFG_REQ_NEG_EVENT          StoppedStRcvCfgReqNegEv        REQ_SENT_STATE
RCV_CFG_ACK_EVENT              StoppedStRcvCfgAckEv           STOPPED_STATE
RCV_CFG_NACK_EVENT             StoppedStRcvCfgNackEv          STOPPED_STATE
RCV_CODE_REJECT_POS_EVENT      RcvCodeRejectPosEv             STOPPED_STATE
RCV_CODE_REJECT_NEG_EVENT      StoppedStRcvCodeRejectNegEv    STOPPED_STATE
RCV_ECHO_REQ_REPLY_EVENT       RcvEchoReqReplyEv              STOPPED_STATE

} // STOPPED

912
state CLOSING_STATE
{
DOWN_EVENT                     ClosingStDownEv                INITIAL_STATE
OPEN_EVENT                     ClosingStOpenEv                STOPPING_STATE
TIMEOUT_POS_EVENT              ClosingStTimeoutPosEv          CLOSING_STATE
TIMEOUT_NEG_EVENT              ClosingStTimeNegEv             CLOSED_STATE
RCV_TERM_ACK_EVENT             ClosingStRcvTermAckEv          CLOSED_STATE
RCV_CODE_REJECT_POS_EVENT      RcvCodeRejectPosEv             CLOSING_STATE
RCV_CODE_REJECT_NEG_EVENT      RcvCodeRejectNegEv             CLOSED_STATE
RCV_ECHO_REQ_REPLY_EVENT       RcvEchoReqReplyEv              CLOSING_STATE
} // CLOSING
```

FIG. 9F

```
914
 \_state STOPPING_STATE
   {
   DOWN_EVENT                     StoppingStDownEv            STARTING_STATE
   CLOSE_EVENT                    -                           CLOSING_STATE
   TIMEOUT_POS_EVENT              StoppingStTimeoutPosEv      STOPPING_STATE
   TIMEOUT_NEG_EVENT              StoppingStTimeNegEv         STOPPED_STATE
   RCV_TERM_ACK_EVENT             StoppingStRcvTermAckEv      STOPPED_STATE
   RCV_CODE_REJECT_POS_EVENT      RcvCodeRejectPosEv          STOPPING_STATE
   RCV_CODE_REJECT_NEG_EVENT      RcvCodeRejectNegEv          STOPPED_STATE
   RCV_ECHO_REQ_REPLY_EVENT       RcvEchoReqReplyEv           STOPPING_STATE

   } // STOPPING
916
 \_state REQ_SENT_STATE
   {
   DOWN_EVENT                     ReqSentStDownEv             STARTING_STATE
   CLOSE_EVENT                    ReqSentStCloseEv            CLOSING_STATE
   TIMEOUT_POS_EVENT              ReqSentStTimeoutPosEv       REQ_SENT_STATE
   TIMEOUT_NEG_EVENT              ReqSentStTimeNegEv          STOPPED_STATE
   RCV_CFG_REQ_POS_EVENT          ReqSentStRcvCfgReqPosEv     ACK_SENT_STATE
   RCV_CFG_REQ_NEG_EVENT          ReqSentStRcvCfgReqNegEv     REQ_SENT_STATE
   RCV_CFG_ACK_EVENT              ReqSentStRcvCfgAckEv        ACK_RCVD_STATE
   RCV_CFG_NACK_EVENT             ReqSentStRcvCfgNackEv       REQ_SENT_STATE
   RCV_CODE_REJECT_POS_EVENT      RcvCodeRejectPosEv          REQ_SENT_STATE
   RCV_CODE_REJECT_NEG_EVENT      RcvCodeRejectNegEv          STOPPED_STATE
   RCV_ECHO_REQ_REPLY_EVENT       RcvEchoReqReplyEv           REQ_SENT_STATE

   } // REQ_SENT_STATE
```

FIG. 9G

```
918
 ~ state ACK_RCVD_STATE
   {
   DOWN_EVENT                     AckRcvdStDownEv              STARTING_STATE
   CLOSE_EVENT                    AckRcvdStCloseEv             CLOSING_STATE
   TIMEOUT_POS_EVENT              AckRcvdStTimeoutPosEv        REQ_SENT_STATE
   TIMEOUT_NEG_EVENT              AckRcvdStTimeNegEv           STOPPED_STATE
   RCV_CFG_REQ_POS_EVENT          AckRcvdStRcvCfgReqPosEv      OPENED_STATE
   RCV_CFG_REQ_NEG_EVENT          AckRcvdStRcvCfgReqNegEv      ACK_RCVD_STATE
   RCV_CFG_ACK_EVENT              AckRcvdStRcvCfgAckEv         REQ_SENT_STATE
   RCV_CFG_NACK_EVENT             AckRcvdStRcvCfgNackEv        REQ_SENT_STATE
   RCV_TERM_REQ_EVENT             AckRcvdStRcvTermReqEv        REQ_SENT_STATE
   RCV_TERM_ACK_EVENT             -                            REQ_SENT_STATE
   RCV_UNKN_CODE_EVENT            -                            ACK_RCVD_STATE
   RCV_CODE_REJECT_POS_EVENT      RcvCodeRejectPosEv           REQ_SENT_STATE
   RCV_CODE_REJECT_NEG_EVENT      RcvCodeRejectNegEv           STOPPED_STATE
   RCV_ECHO_REQ_REPLY_EVENT       RcvEchoReqReplyEv            ACK_RCVD_STATE

   } // ACK_RCVD_STATE

920
 ~ state ACK_SENT_STATE
   {
   DOWN_EVENT                     AckSentStDownEv              STARTING_STATE
   CLOSE_EVENT                    AckSentStCloseEv             CLOSING_STATE
   TIMEOUT_POS_EVENT              AckSentStTimeoutPosEv        ACK_SENT_STATE
   TIMEOUT_NEG_EVENT              AckSentStTimeNegEv           STOPPED_STATE
```

```
RCV_CFG_REQ_POS_EVENT         AckSentStRcvCfgReqPosEv           ACK_SENT_STATE
RCV_CFG_REQ_NEG_EVENT         AckSentStRcvCfgReqNegEv           REQ_SENT_STATE
RCV_CFG_ACK_EVENT             AckSentStRcvCfgAckEv              OPENED_STATE
RCV_CFG_NACK_EVENT            AckSentStRcvCfgNackEv             ACK_SENT_STATE
RCV_TERM_REQ_EVENT            AckSentStRcvTermReqEv             REQ_SENT_STATE
RCV_CODE_REJECT_POS_EVENT     RcvCodeRejectPosEv                ACK_SENT_STATE
RCV_CODE_REJECT_NEG_EVENT     RcvCodeRejectNegEv                STOPPED_STATE
RCV_ECHO_REQ_REPLY_EVENT      RcvEchoReqReplyEv                 ACK_SENT_STATE

} // ACK_SENT_STATE

922
 state OPENED_STATE
{
DOWN_EVENT                    OpenedStDownEv                    STARTING_STATE
OPEN_EVENT
\
          switch(enabledRestart ())
\
      {
\
          TRANSITION_CNST_TRUE:  OpenedStOpenEvEnabledRestartTRUE  OPENED_STATE
\
      }
\
```

FIG. 9H

FIG. 9I

```
CLOSE_EVENT                     OpenedStCloseEv                 CLOSING_STATE
RCV_CFG_REQ_POS_EVENT           OpenedStCfgReqPosEv             ACK_SENT_STATE
RCV_CFG_REQ_NEG_EVENT           OpenedStRcvCfgReqNegEv          REQ_SENT_STATE
RCV_CFG_ACK_EVENT               OpenedRcvCfgAckEv               REQ_SENT_STATE
RCV_CFG_NACK_EVENT              OpenedStRcvCfgNackEv            REQ_SENT_STATE
RCV_TERM_REQ_EVENT              OpenedStRcvTermReqEv            STOPPING_STATE
RCV_TERM_ACK_EVENT              OpenedStRcvTermAckEv            REQ_SENT_STATE
RCV_CODE_REJECT_POS_EVENT       RcvCodeRejectPosEv              OPENED_STATE
RCV_CODE_REJECT_NEG_EVENT       OpenedStRcvCodeRejectNegEv      STOPPING_STATE
RCV_ECHO_REQ_REPLY_EVENT        RcvEchoReqReplyEv               OPENED_STATE

} // OPENED_STATE

}
```

FIG. 10

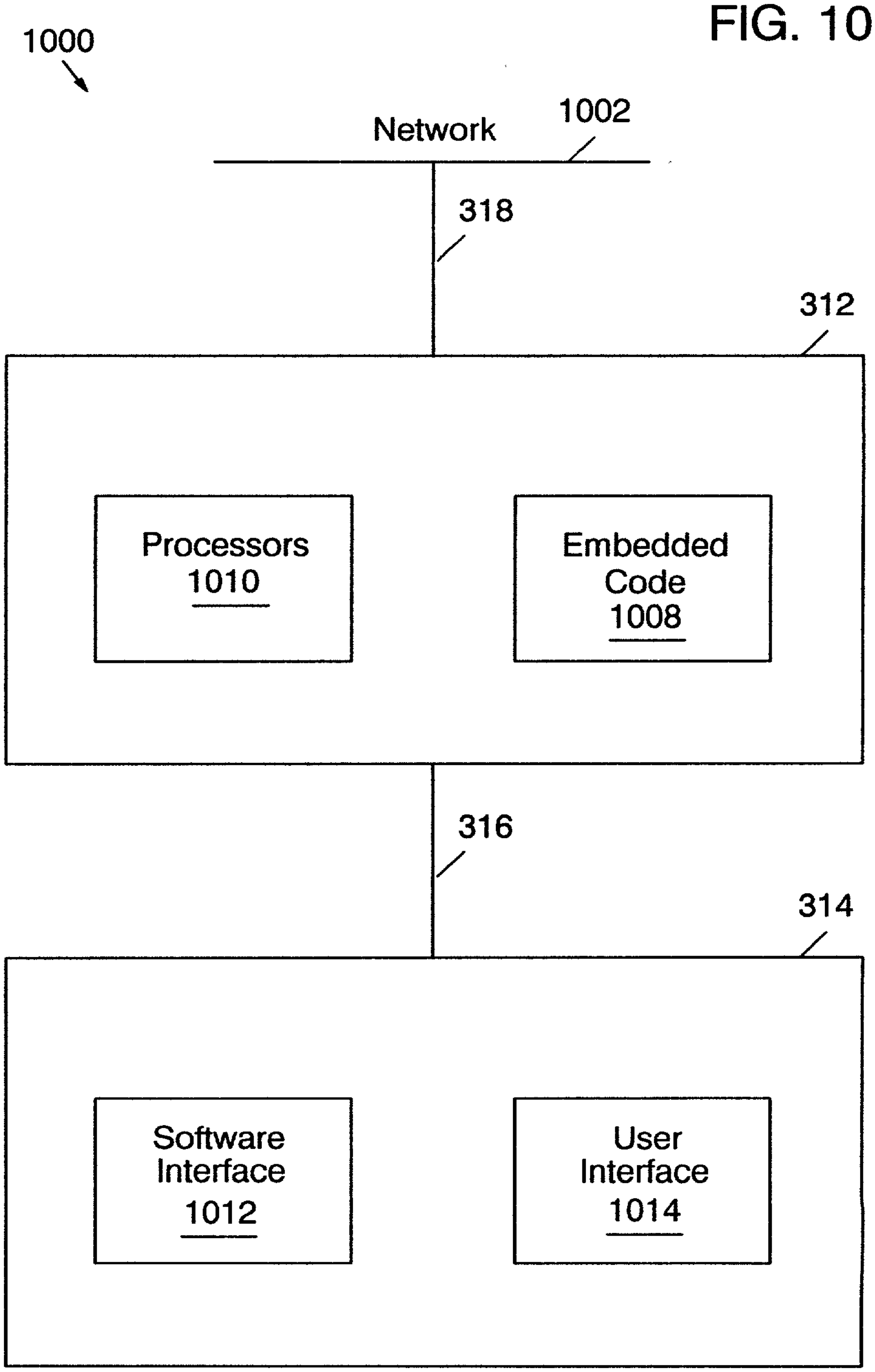

1000
Network
1002
318
312
Processors
1010
Embedded
Code
1008
316
314
Software
Interface
1012
User
Interface
1014

FIG. 11

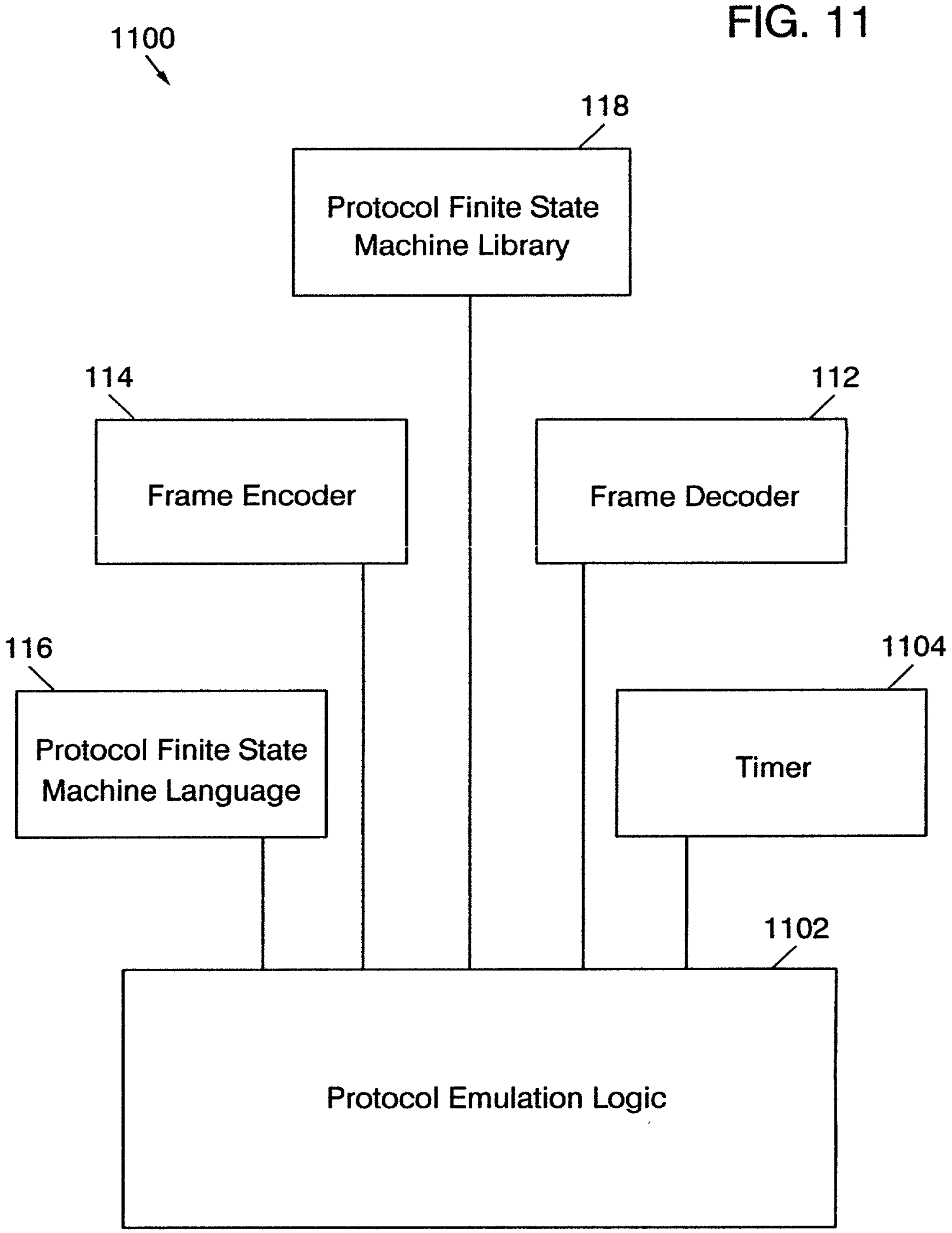

1100
118
Protocol Finite State Machine Library
114
Frame Encoder
112
Frame Decoder
116
Protocol Finite State Machine Language
1104
Timer
1102
Protocol Emulation Logic

FIG. 12A

1202

Events	State 0 Initial	1 Starting	2 Closed	3 Stopped	4 Closing	5 Stopping
Up	2	tc1,6	-	-	-	-
Down	-	-	0	1	0	1
Open	1	1	tc1,3/tc2,6	tc3,3r	5r	5r
Close	0	0	2	2	4	4
TO+	-	-	-	-	4	5
TO-	-	-	-	-	2	3
RCR+	-	-	2	8	4	5
RCR-	-	-	2	6	4	5
RCA	-	-	2	3	4	5
RCN	-	-	2	3	4	5
RTR	-	-	2	3	4	5
RTA	-	-	2	3	2	3
RUC	-	-	2	3	4	5
RXJ+	-	-	2	3	4	5
RXJ-	-	-	2	3	2	3
RXR	-	-	2	3	4	5

FIG. 12B

1204

Events	State 6 Req-Sent	7 Ack-Rcvd	8 Ack-Sent	9 Opened
Up	-	-	-	-
Down	1	1	1	1
Open	6	7	8	tc3,9r
Close	4	4	4	4
TO+	6	6	8	-
TO-	3p	3p	3p	-
RCR+	8	9	8	8
RCR-	6	7	6	6
RCA	7	6	9	6
RCN	6	6	8	6
RTR	6	6	6	5
RTA	6	6	8	6
RUC	6	7	8	9
RXJ+	6	6	8	9
RXJ-	3	3	3	5
RXR	6	7	8	9

[p]	Passive option
[r]	Restart option
[s]	Silent option

// Transition conditions

tc1 - (enabledSilent() == TRUE)
tc2 - (enabledSilent() == FALSE)
tc3 - (enabledRestart() == TRUE)

FIG. 13

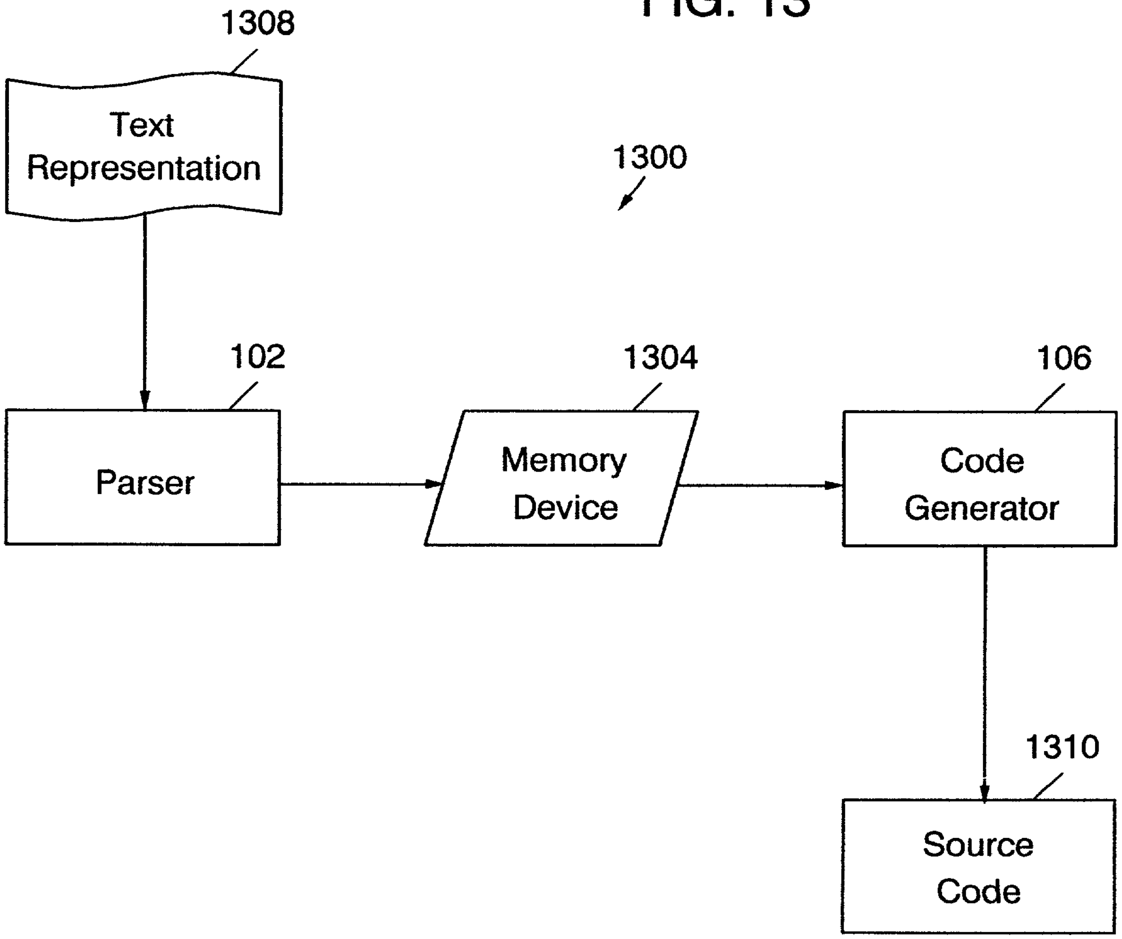

1308
Text Representation
1300
102
Parser
1304
Memory Device
106
Code Generator
1310
Source Code

FIG. 14

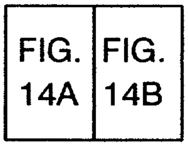


FIG. 14A

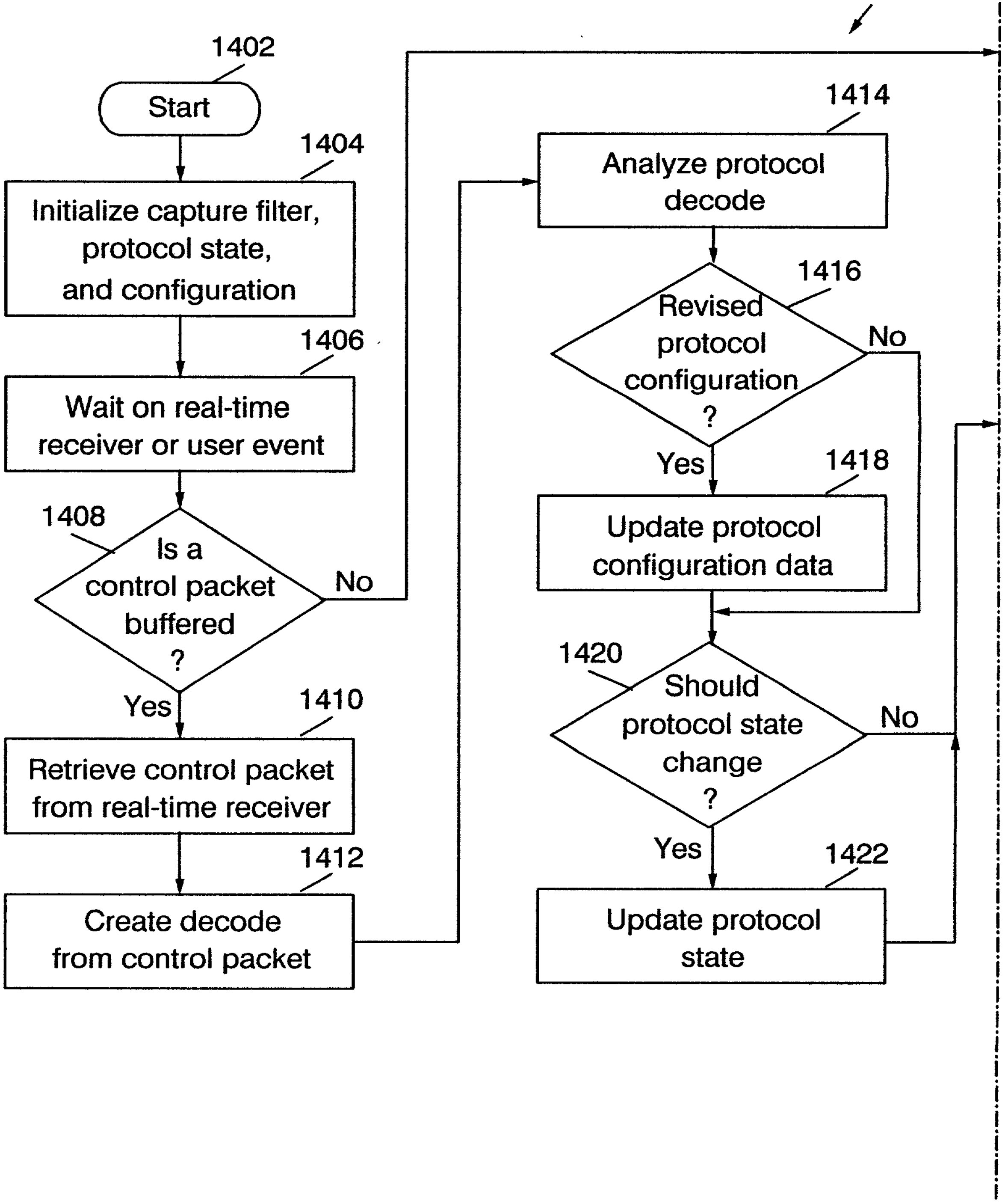


FIG. 14B

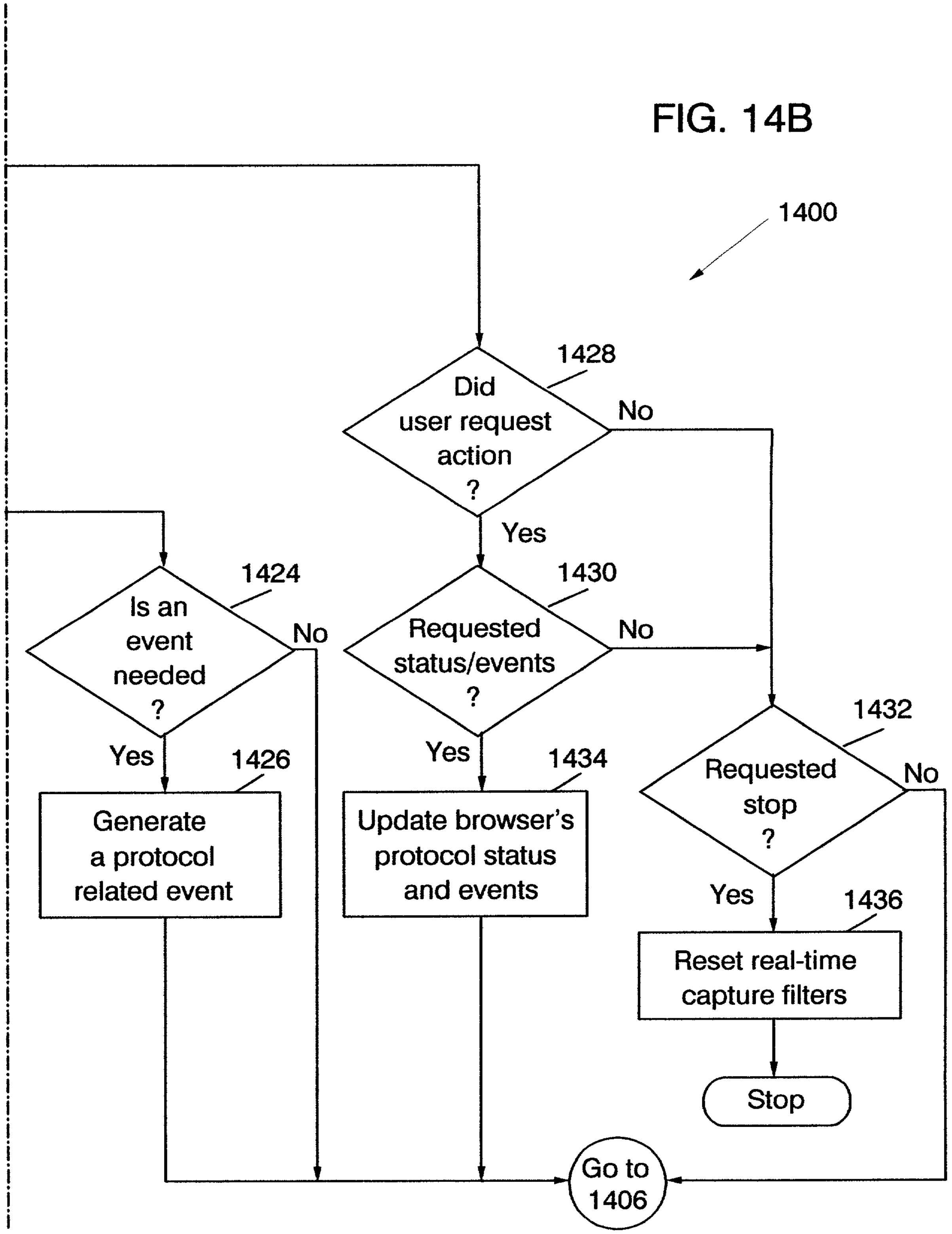

1400
1428
Did user request action ?
No
Yes
1424
Is an event needed ?
No
Yes
1430
Requested status/events ?
No
Yes
1432
Requested stop ?
No
Yes
1426
Generate a protocol related event
1434
Update browser's protocol status and events
1436
Reset real-time capture filters
Stop
Go to 1406

FIG. 15

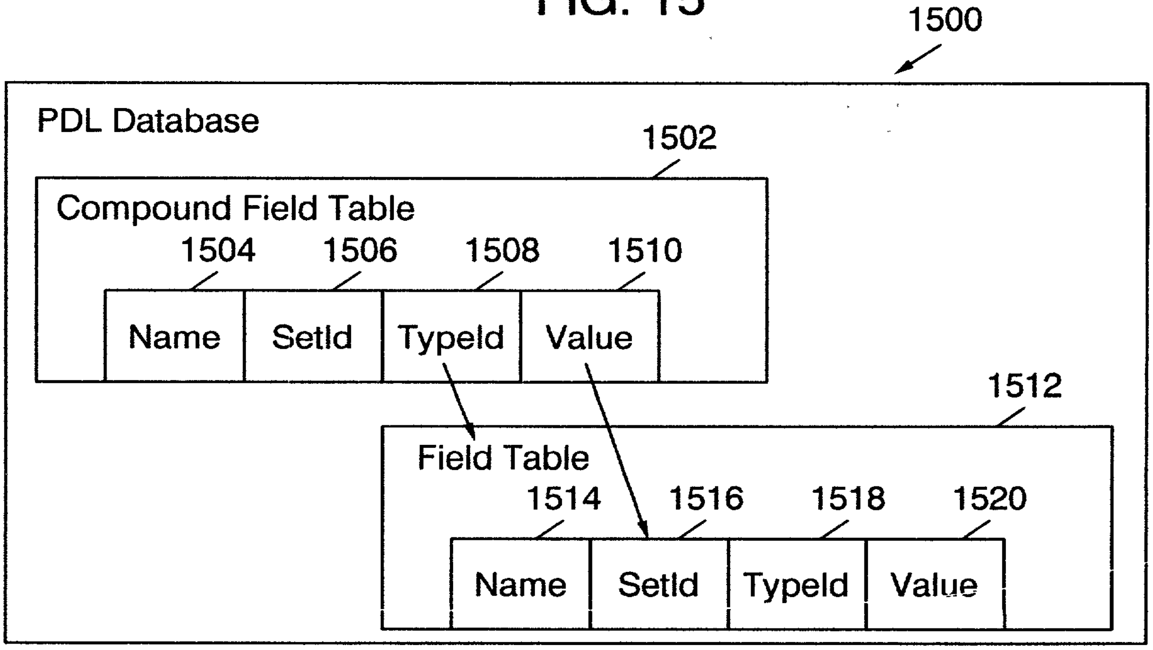
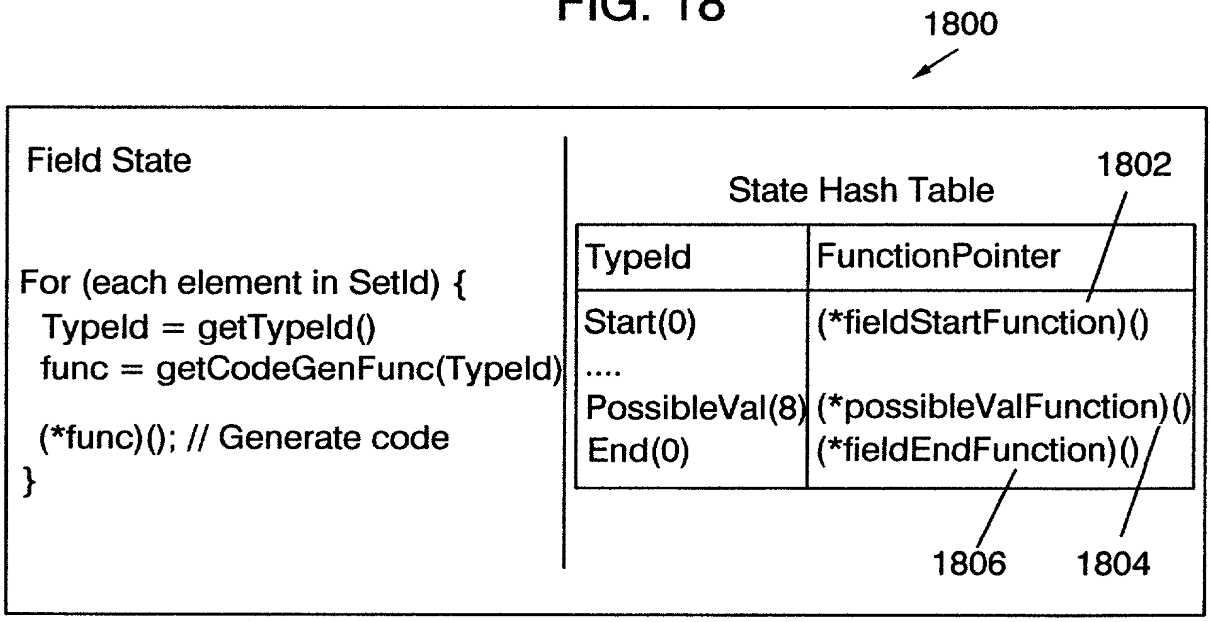


FIG. 18



```
For (each element in SetId) {
  TypeId = getTypeId()
  func = getCodeGenFunc(TypeId)

  (*func)(); // Generate code
}
```

TypeId	FunctionPointer
Start(0)	(*fieldStartFunction)()
....	
PossibleVal(8)	(*possibleValFunction)()
End(0)	(*fieldEndFunction)()

FIG. 16

1600

1602 1604 1606 1608

1610 1612

TypeId	TypeName	TableName	Type	Comment
0	Start		Control	
0	ProtocolNames	ProtocolNames		
1	Protocol	Protocol	Compound	
2	Header	Header	Compound	
3	Payload	Payload	Compound	
4	Trailer	Trailer	Compound	
5	CompountField	CompountField	Compound	
6	Repeat	Repeat	Compound	
7	Switch	Switch	Compound	
8	PossibleValues	PossibleValues	Attribute	
9	Field	Field	Simple	
10	Len	Len	Attribute	
11	MinLen	Len	Attribute	
12	MaxLen	Len	Attribute	
13	Display	Display	Attribute	
14	Encode	Encode	Attribute	
15	Default	Default	Attribute	
16	Break	Len	Attribute	
17	Optional	Len	Attribute	
18	Offset	Len	Attribute	
19	Name	Name	Attribute	
20	Description	Description	Attribute	
21	String	String		
22	End	End	Control	
23	DecisiveField	Field	Simple	
24	FieldType	Attribute	Attribute	
28	MinVal	Attribute	Attribute	
29	MaxVal	Attribute	Attribute	
30	Count	Len	Attribute	

FIG. 17

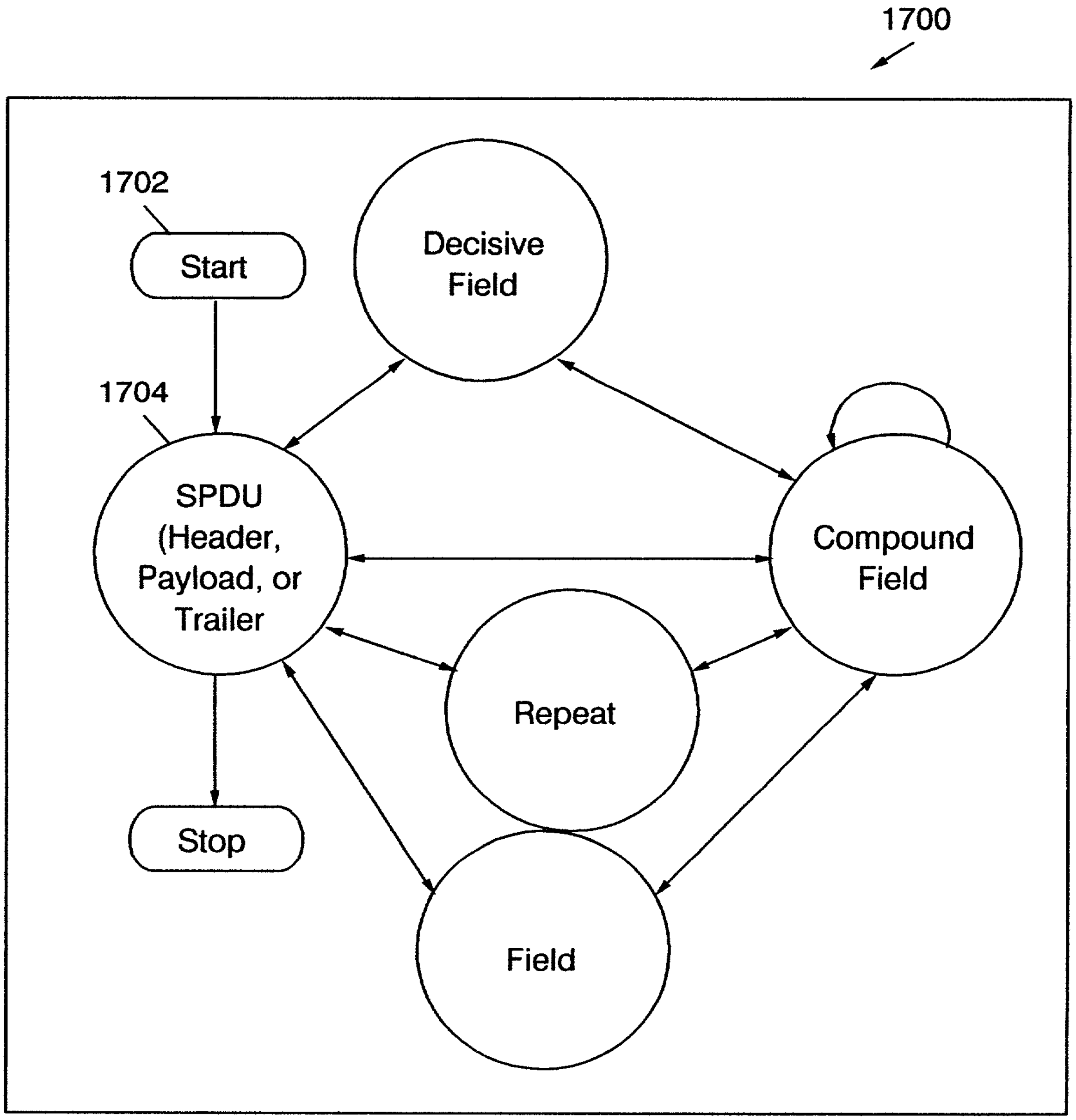
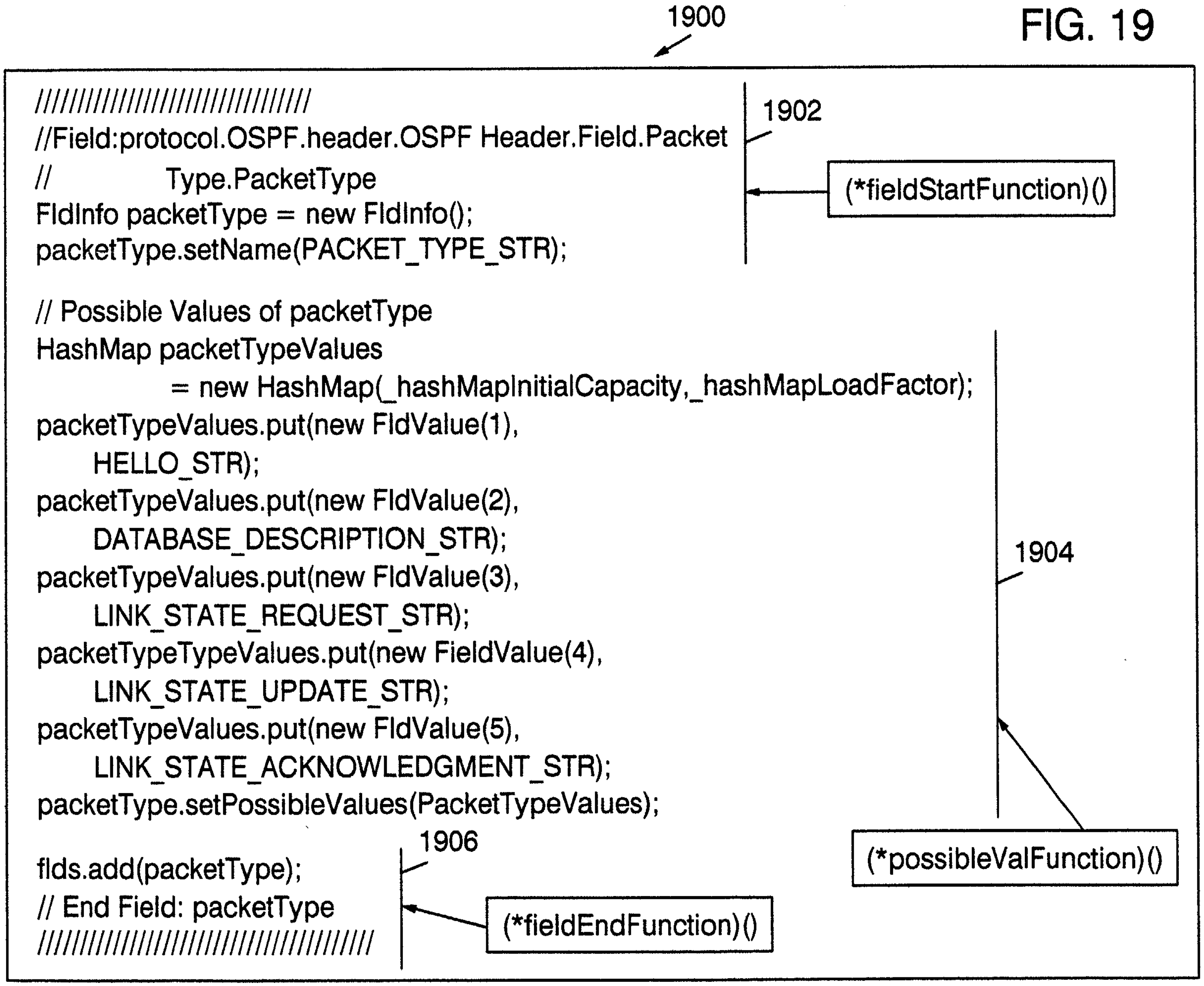

1700
1702
Start
Decisive Field
1704
SPDU (Header, Payload, or Trailer
Compound Field
Repeat
Stop
Field

FIG. 19

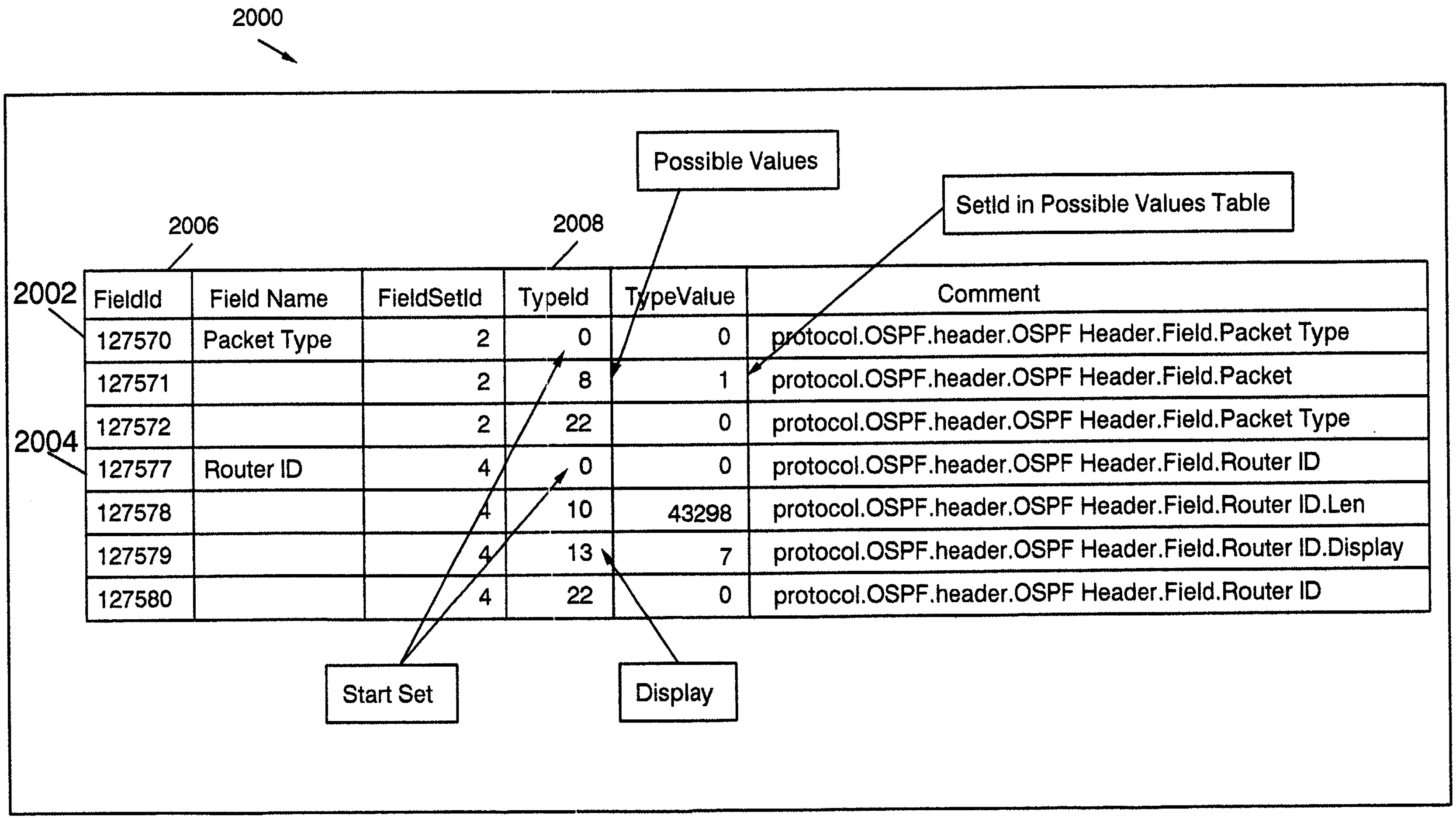


```
////////////////////////////////
//Field:protocol.OSPF.header.OSPF Header.Field.Packet
//            Type.PacketType
FldInfo packetType = new FldInfo();
packetType.setName(PACKET_TYPE_STR);

// Possible Values of packetType
HashMap packetTypeValues
              = new HashMap(_hashMapInitialCapacity,_hashMapLoadFactor);
packetTypeValues.put(new FldValue(1),
      HELLO_STR);
packetTypeValues.put(new FldValue(2),
      DATABASE_DESCRIPTION_STR);
packetTypeValues.put(new FldValue(3),
      LINK_STATE_REQUEST_STR);
packetTypeTypeValues.put(new FieldValue(4),
      LINK_STATE_UPDATE_STR);
packetTypeValues.put(new FldValue(5),
      LINK_STATE_ACKNOWLEDGMENT_STR);
packetType.setPossibleValues(PacketTypeValues);

flds.add(packetType);
// End Field: packetType
/////////////////////////////////////
```

FIG. 20



FieldId	Field Name	FieldSetId	TypeId	TypeValue	Comment
127570	Packet Type	2	0	0	protocol.OSPF.header.OSPF Header.Field.Packet Type
127571		2	8	1	protocol.OSPF.header.OSPF Header.Field.Packet
127572		2	22	0	protocol.OSPF.header.OSPF Header.Field.Packet Type
127577	Router ID	4	0	0	protocol.OSPF.header.OSPF Header.Field.Router ID
127578		4	10	43298	protocol.OSPF.header.OSPF Header.Field.Router ID.Len
127579		4	13	7	protocol.OSPF.header.OSPF Header.Field.Router ID.Display
127580		4	22	0	protocol.OSPF.header.OSPF Header.Field.Router ID

FIG. 21

Protocol	Status	Time	Mode
LCP	Open	09/04/00 08:01:03 AM	Emulate
IPCP	Negotiating	09/04/00 08:01:07 AM	Monitor
MPLSCP	Closed	09/04/00 08:01:05 AM	Monitor
RSVP	N/a	09/04/00 08:01:00 AM	Disabled

FIG. 22

	Rx1	Rx2
Current Status	Open	Negotiating
Loop-back	No	No
Unanswered Echo Requests	0	0
Maximum Receive Unit	512	1500
Asynchronous Character Map	0	0
Authentication Protocol	Unknown	Unknown
Quality Protocol	N/a	N/a
Protocol Field Compression	Off	Off
Address/Control Field Compression	Off	Off
Magic Number	0xFF	0x1FF
FCS Alternative	CCITT 32-bit	CCITT 32-bit

FIG. 23

FIG. 23A
FIG. 23B

FIG. 23A

Time	Recvr	Protocol	MsgType	Event	Synopsis
09/04/00 08:01:01 AM	Rx1	LCP	ConfigReq	Protocol Negotiating	ACComp:On,Pcomp:On,Magic.0x1ab82049
09/04/00 08:01:01 AM	Rx2	LCP	ConfigAck	Open Protocol	ACComp:On,Pcomp:On,Magic.0x4e3d9123
09/04/00 08:01:02 AM	Rx2	LCP	ConfigReq	Protocol Negotiating	ACComp:On,Pcomp:On,Magic.0x1ab82049
09/04/00 08:01:03 AM	Rx1	LCP	ConfigAck	Open Protocol	ACComp:On,Pcomp:On,Magic.0x1ab82049
09/04/00 08:01:04 AM	Rx2	IPCP	ConfigReq	Protocol Negotiating	Local IP: 198.85.38.199
09/04/00 08:01:06 AM	Rx1	IPCP	ConfigAck	Open Protocol	Local IP: 198.85.38.199
09/04/00 08:01:06 AM	Rx1	IPCP	ConfigReq	Protocol Negotiating	Local IP: 198.85.34.35
09/04/00 08:01:06 AM	Rx2	IPCP	ConfigAck	Open Protocol	Local IP: 198.85.34.35
09/04/00 08:01:10 AM	Rx2	MPLSCP	ConfigReq	Protocol Negotiating	
09/04/00 08:01:12 AM	Rx2	MPLSCP	TermReq	Close Protocol	
09/04/00 08:11:01 AM	Rx1	RSVP	Rx1	Rx1	Resv Request <session: 198.85.34.45 UDP port 14>

09/04/00 08:11:03 AM	Rx1	RSVP	Rx1	Rx1	Resv Confirm <session: 198.85.34.45 UDP port 14>
09/04/00 08:11:04 AM	Rx2	RSVP	Rx2	Rx2	Path Request <session: 198.85.38.199 UDD port 0x82A>
09/04/00 08:11:06 AM	Rx1	RSVP	Rx1	Rx1	Resv Error <session: 198.85.38.199 UDP port 0x82A>
09/04/00 09:21:10 AM	Rx2	RSVP	Rx2	Rx2	Path Request <session: 198.85.38.199 UDP port 0x82A>
09/04/00 09:21:12 AM	Rx2	RSVP	Rx2	Rx2	Resv Confirm <session: 198.85.38.199 UPD port 0x82A>
09/04/00 09:21:30 AM	Rx1	RSVP	Rx1	Rx1	Path Tear <session: 198.85.34.45 UPD port 14>
09/04/00 09:21:32 AM	Rx2	RSVP	Rx2	Rx2	Resv Tear <session: 198.85.34.45 UPD port 14>
09/04/00 09:21:32 AM	Rx2	RSVP	Rx2	Rx2	Resv Tear <session: 198.85.34.45 UPD port 14>
09/04/00 11:44:30 PM	Rx1	IPCP	TermReq	Close Protocol	
09/04/00 11:44:31 PM	Rx1	IPCP	TermAck	Close Protocol	
09/04/00 11::44:32 PM	Rx1	LCP	TermReq	Close Protocol	
09/04/00 11:44:33 PM	Rx2	LCP	TermAck	Close Protocol	

FIG. 23B